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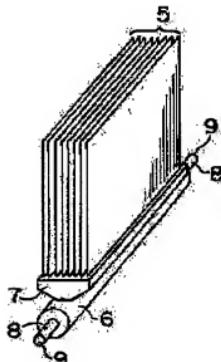
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(54) HOLLOW FIBER MEMBRANE MODULE AND HOLLOW FIBER MEMBRANE MODULE UNIT USING THE SAME



## (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a hollow fiber membrane module in which the cleaning of membrane surfaces is easy and which is particularly suitable for filtering a liquid of high turbidity due to organic substances and a hollow fiber membrane module unit using the module.

**SOLUTION:** In the hollow fiber membrane module, one end part or both end parts of the hollow fiber membrane formed in the shape of a sheet are fixed by a fixing member in a housing while the hollow fiber membrane is opened. The module is arranged so that the longitudinal direction of the hollow fiber membrane of the module is perpendicular. In the hollow fiber membrane module unit, such module is used.

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## CLAIMS

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[Claim(s)]

[Claim 1]A one end part or both ends of a hollow fiber to make a sheet shaped by a holdown member in housing. A hollow fiber module arranging as it consists of a hollow fiber module which it comes to fix maintaining an opening state of this hollow fiber and the length direction of said hollow fiber of this hollow fiber module moreover turns into the perpendicular direction.

[Claim 2]The hollow fiber module according to claim 1, wherein a hollow fiber which makes a sheet shaped of two or more sheets is arranged and a holdown member is being fixed to a catchment pipe.

[Claim 3]A hollow fiber module unit, wherein it stands in a row or laminates and plurality of the hollow fiber module according to claim 1 or 2 is arranged.

[Claim 4]It is a hollow fiber module unit which it comes to arrange by plurality of the hollow fiber module according to claim 1 or 2 standing in a row, And in the 1st hollow fiber module and the 2nd hollow fiber module which adjoin mutually and are arranged, A hollow fiber which makes a sheet shaped of the hollow fibers which make a sheet shaped in the 1st hollow fiber module arranged most at the 2nd hollow fiber module side, A hollow fiber module unit to which distance between hollow fibers which make a sheet shaped of the hollow fibers which make a sheet shaped in the 2nd hollow fiber module arranged most at the 1st hollow fiber module side is characterized by being 5-100 mm.

[Claim 5]A hollow fiber module unit provided with an aeration pipe, wherein an aeration pipe unifies and is attached to the hollow fiber module unit according to claim 3 or 4.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application]Especially this invention relates to the hollow fiber module unit which uses a suitable hollow fiber module to use when filtering the high fluid of contamination nature (contamination nature by an organic nature substance), and this hollow fiber module.

[0002]

[Description of the Prior Art]Although many filtration by a hollow fiber module has been conventionally performed in the so-called field of precision filtration of manufacture of aseptic water, drinking water, or a high purity water, purification of air, etc., In recent years, examination applied to the processing use of high polluted water, such as secondary treatment in sewage works, tertiary treatment, and solid liquid separation in a septic tank, is performed variously.

[0003] The hollow fiber module used for such a use, it is large, and a hollow fiber is vibrated and it must perform [ air must be sent after the filtration treatment of fixed time, and blinding of the hollow fiber at the time of filtration treatment must repeat film surface washing of washing a membrane surface or letting treated water flow to filtration treatment and an opposite direction, and ] it.

[0004] The circle configuration for which the hollow fiber module used in these fields has been used in the field of the conventional precision filtration, and the cylindrical shape type thing which converged and arranged the hollow fiber concentrically were almost the case. Though improvement was performed, only many changed the filling factor and infilled type voice of the hollow fiber.

[0005]

[Problem(s) to be Solved by the Invention] If filtration treatment of high polluted water (for example,  $ss >= 50$  mg/L,  $TOC >= 100$  mg/L) is performed using the above conventional hollow fiber modules, It will follow on progress of use of a hollow fiber module, an organic matter etc. will adhere and accumulate on the hollow fiber surface, and hollow fibers will adhere and (adhesion) unify via this sediment. And by this, the effective membrane area of the hollow fiber in a hollow fiber module decreases, and the rapid fall of a filtration flow rate arises. Even if it is performing film surface washing and the back wash of the hollow fiber periodically, said thing [ aiming at functional recovery of a module, if it is made like and hollow fibers adhere and unify ] is not easy, and washing efficiency falls.

[0006] The one end part or both ends of a hollow fiber which change to the hollow fiber module of a cylindrical shape with a converged type, arrange a hollow fiber to a sheet shaped as solution of this problem, and make this sheet shaped by the bridging in one or two different housing. It consists of a hollow fiber module which it makes it come to fix maintaining the opening state of a hollow fiber, respectively, and the long and slender hollow fiber module which makes a rectangle mostly is proposed for each shape of the section vertical to the hollow fiber of a holdown member.

[0007] The hollow fiber module of the flat tip which arranges this hollow fiber to a sheet shaped, It is possible to keep an interval and to arrange uniformly the hollow fibers which make a sheet shaped in an inside-and-outside layer, and washing of a film surface is faced, It is very easy to wash the hollow fiber surface uniformly, and since decline in a filtration efficiency can be suppressed by this, it is suitable to use for filtration of high polluted water.

[0008] By the way, to process mass (for example,  $1m^3/h$ ) water using the hollow fiber module of the flat tip which arranges this hollow fiber to a sheet shaped, it is necessary to extend a membrane area but, and, Since handling becomes difficult, and a processing tub becomes large more than needed and a hollow fiber will moreover be accumulated when the membrane area of a hollow fiber module is enlarged, when performing scrubbing washing etc., there is a problem of it becoming impossible to wash the whole film surface in a module efficiently with air etc.

[0009] As the directions for the hollow fiber module of the flat tip which arranges the conventional hollow fiber to a sheet shaped, in order to increase a membrane area, may increase and carry out unitization of the number of modules, but, In this case, the hollow fiber module arrangement (namely, interval of an inter module when arranging in parallel and arranging a module so that a sheet shaped hollow fiber may be piled up) in a unit, Since the path of the catchment pipe of each hollow fiber module rules over, there is also a problem that there is a limit in narrowing the distance between hollow fiber modules.

[0010]Therefore, it is an interval (in the flat tip hollow fiber module which uses a sheet shaped hollow fiber.) of a hollow fiber module more than needed. The interval of the hollow fiber which makes a sheet shaped opens, and there is a problem which the capacity of a processing tub must become large in connection with it more than needed, or must stop having to increase the amount of bubbling for scrubbing.

[0011]Therefore, even if the purpose of this invention enlarges the membrane area of a hollow fiber, its space which a water collecting part occupies is small, It is in providing the hollow fiber module unit which uses the hollow fiber module which is made into a compact structure and can moreover perform scrubbing washing to the whole hollow fiber in a module efficiently by this, and this hollow fiber module.

[0012]

[Means for Solving the Problem]A hollow fiber module unit which uses a hollow fiber module and this hollow fiber module of this invention by composition indicated below can attain said purpose. Namely, a one end part or both ends of a hollow fiber which make a sheet shaped a hollow fiber module of this invention by a holdown member in housing. It is the hollow fiber module arranged as it consists of a hollow fiber module which it comes to fix maintaining an opening state of this hollow fiber and the length direction of said hollow fiber of this hollow fiber module moreover turns into the perpendicular direction.

[0013]As for a hollow fiber module of this invention by said composition, it is preferred that a hollow fiber which makes a sheet shaped of two or more sheets is arranged, and a holdown member is being fixed to a catchment pipe.

[0014]Plurality of a hollow fiber module according [ a hollow fiber module unit of this invention ] to said composition is parallel or a thing which it laminates and comes to arrange.

[0015]A hollow fiber module unit of this invention, It is a hollow fiber module unit which it comes to arrange by plurality of a hollow fiber module of this invention provided with said composition standing in a row, And in the 1st hollow fiber module and the 2nd hollow fiber module which adjoin mutually and are arranged, A hollow fiber which makes a sheet shaped of the hollow fibers which make a sheet shaped in the 1st hollow fiber module arranged most at the 2nd hollow fiber module side, Distance between hollow fibers which make a sheet shaped of the hollow fibers which make a sheet shaped in the 2nd hollow fiber module arranged most at the 1st hollow fiber module side is in 5-100 mm.

[0016]In a hollow fiber module unit by said composition, it is preferred that it is the hollow fiber module unit attached to this hollow fiber module unit by an aeration pipe unifying.

[0017]Below, concrete composition of a hollow fiber module unit which uses a hollow fiber module and this hollow fiber module of this invention is explained with reference to drawings.

[0018]Eight hollow fibers which make a sheet shaped which consists of a hollow fiber knit fabric are used for drawing 1, By a holdown member, are a one end part of each hollow fiber a perspective view of a fixed hollow fiber module, maintaining an opening state of this hollow fiber, and this hollow fiber module, When area of the holdown-member end face where A and a hollow fiber are carrying out the opening of the area of a holdown-member side of a side with long and slender shape of a section vertical to a hollow fiber of a holdown member which has a rectangle mostly and a hollow fiber exposes from a holdown member is set to B, A relation of  $100 \geq A/B \geq 1.2$  is satisfied and A/B is set as 1.7 in a hollow fiber module shown in drawing 1.

[0019]Drawing 2 is a perspective view of a hollow fiber module which fixed both ends of each hollow fiber by

a holdown member using eight hollow fibers which make a sheet shaped which consists of a hollow fiber knit fabric like drawing 1 maintaining an opening state of this hollow fiber.

[0020]Drawing 3 is a sectional view of a hollow filament holding part in a direction vertical to a longitudinal direction of a catchment pipe of a hollow fiber module shown in drawing 1 and drawing 2.

[0021]In the above drawing 1 – drawing 3, as for a hollow fiber knit fabric and the numerals 6 to which the numerals 3 make a hollow fiber open end side, and the numerals 5 make a sheet shaped, housing and a catchment pipe, and the numerals 7 show a holdown member, the numerals 8 show a conduit tube, and the numerals 9 show filtrate output port, respectively.

[0022]As illustrated to drawing 1 and drawing 2, a sheet shaped hollow fiber by a hollow fiber knit fabric is used, In a hollow fiber module with long and slender shape of a section vertical to a hollow fiber of a holdown member in which it comes to fix them by a holdown member in a structural material a one end part or both ends of the hollow fiber maintaining an opening state of this hollow fiber and which is a rectangle mostly, When area of the holdown-member end face where A and a hollow fiber are carrying out the opening of the area of a holdown-member side of a side which a hollow fiber exposes from a holdown member is set to B, By making it a hollow fiber module with which it is satisfied of  $100 \geq A/B \geq 1.2$ , even if it enlarges a membrane area of a hollow fiber, a space which a water collecting part occupies becomes small, and it becomes possible to use a hollow fiber module of a compact structure by this.

[0023]In the hollow fiber knit fabric 5 as a hollow fiber which makes a sheet shaped. For example, what can use what consists of various kinds of materials, such as a cellulose type, a polyolefin system, a polyvinyl alcohol system, and a polysulfone system, and is especially depended on high construction material of strong ductility, such as polyethylene and polypropylene, is preferred.

[0024]What is necessary is just usable as a filtration membrane in a hollow fiber, and An aperture, Although there is no restriction in particular of a void content, thickness, an outer diameter, etc., 0.01–1 micrometer in an aperture from viewpoints of a removal subject, reservation of a membrane area per capacity, intensity of a hollow fiber, etc., etc., 20 to 90% of a void content, thickness of 5–300 micrometers, and an outer diameter of 20–2000 micrometers are preferred. When it is required to be 0.2 micrometer or less in an aperture when especially aiming at removal of bacteria and it aims at removal of an organic matter or a virus, it may be made hundreds of thousands of ultrafiltration membrane from 10,000 cuts off molecular weight.

[0025]It is desirable that it is what is called a lasting hydrophilization film that possesses a hydrophilic radical etc. on the surface as a surface characteristic of a hollow fiber. As a process of a lasting hydrophilization film, publicly known methods, such as a method of manufacturing a hollow fiber with hydrophilic giant molecules like a polyvinyl alcohol system or the method of carrying out hydrophilization of the surface of a hydrophobic poly membrane, can be used. For example, as an example of hydrophilic giant molecules at the time of carrying out hydrophilization, an ethylene–vinyl acetate system copolymer saponification thing, a polyvinyl pyrrolidone, etc. can be mentioned by giving hydrophilic giant molecules to a film surface of a hydrophobic hollow fiber.

[0026]As an example of film surface hydrophilication by another technique, there is a film surface polymerization method of a hydrophilic monomer, and diacetone acrylamide etc. can be mentioned as an example of this monomer.

[0027]As other techniques, hydrophilic giant molecules can be blended to hydrophobic polymers (for

example, polyolefine), a method of carrying out spinning film production of this can be mentioned, and what was mentioned above is mentioned as an example of hydrophilic giant molecules which can be used.

[0028]A hydrophobic interaction works that the surface is a hydrophobic hollow fiber between an organic matter in treated water, and the hollow fiber surface, organic matter adsorption to a film surface occurs, it leads to a blockade of a film surface, and a filtering life becomes short. Generally it becomes difficult for what is depended on blinding of adsorption origin to aim at recovery of a filtration efficiency by film surface washing.

[0029]On the other hand, if a lasting hydrophilization film is used, a hydrophobic interaction on an organic matter and the surface of a hollow fiber can be decreased, and adsorption of an organic matter can be suppressed. Although desiccation and hydrophobing arise and a fall of flux may be caused by the bubbling air in scrubbing washing in use by a hydrophobic film, even if it dries, a fall of flux is not caused by a lasting hydrophilization film.

[0030]As shown in drawing 1 and drawing 2, either [ which makes a sheet shaped ] a one end part of a hollow fiber or both ends may be available for immobilization of a hollow fiber, and it can choose one of fixing means according to the purpose or a use.

[0031]Using a hollow fiber which makes a sheet shaped, a hollow fiber module of this invention is arranged, as the length direction of a hollow fiber of this hollow fiber module moreover turns into the perpendicular direction. Since an air bubble used for scrubbing washing by making it a hollow fiber module arranged so that the length direction of a hollow fiber may become in the perpendicular direction comes to go up over a film surface, without receiving strong resistance from a film surface, As a result, a climbing speed of an air bubble becomes quick and becomes a hollow fiber module which can perform efficient washing.

[0032]On the other hand, if the length direction of a hollow fiber of a hollow fiber module makes it a hollow fiber module arranged as serves as a horizontal direction and an oblique direction, When an air bubble used for scrubbing washing goes up, in order to collide with a hollow fiber side one after another, a climbing speed of an air bubble becomes slow and becomes what has bad washing efficiency as a result.

[0033]For example, fibrous impurity, such as hair and wash waste, is contained in treated water, when filtering lower wastewater, When the length direction of a hollow fiber makes it a hollow fiber module arranged in a horizontal direction or an oblique direction, such fibrous impurity gets twisted around a hollow fiber easily, and since scrubbing washing of the portion which got twisted is hard to be carried out, a film surface of a hollow fiber tends to be blockaded by this.

[0034]On the other hand, since the aforementioned fibrous impurity becomes what cannot be easily involved in a hollow fiber by making it a hollow fiber module arranged as the length direction of a hollow fiber turns into the perpendicular direction as mentioned above, it becomes a hollow fiber module in which a blockade of a film surface of a hollow fiber does not take place easily.

[0035]The hollow fiber knit fabric 5 as a hollow fiber which makes a sheet shaped is a thing which knit a hollow fiber to a sheet shaped, and can manufacture easily a hollow fiber which makes this sheet shaped by using a device and a method which are indicated, for example to JP.4-26886,B or JP.63-91673,A.

[0036]In drawing 3, the hollow fiber open end side 3 is a portion which takes out filtrate from this end face and sends filtrate to a conduit tube etc. in a hollow fiber module shown in drawing 1 and drawing 2, housing and the catchment pipe 6 function as the whole support member, and long and slender -- it has a

rectangular opening mostly. And an opening of this housing and the catchment pipe 6 is a thing which has long and slender shape of a section vertical to a hollow fiber of a holdown member by which restoration immobilization is carried out there with a hollow fiber and which makes a rectangle mostly.

[0037]Restoration immobilization is carried out, and the holdown member 7 is formed in an opening of housing and the catchment pipe 6 so that it may have shape like drawing 3, but no matter what thing shape may be, it does not interfere. in order that this holdown member 7 may converge and fix each end of many hollow fibers, with an opening state of this hollow fiber maintained and it may operate this hollow fiber as a filtration membrane — treated water and treated water — liquid — it functions as a member divided densely.

[0038]The holdown member 7 usually stiffens liquefied resin, such as an epoxy resin, unsaturated polyester resin, and polyurethane, and is formed. The conduit tube 8 is a pipe with which filtrate flows, and leads to the filtrate output port 9.

[0039]As construction material of housing, the catchment pipe 6, and the conduit tube 8, it has a mechanical strength and endurance and rigid-polyvinyl-chloride resin, polycarbonate, polysulfone, polypropylene, an acrylic resin, ABS plastics, conversion PPE resin, etc. should just be mentioned. It is preferred to make it a thing of construction material which consists of resin of a hydrocarbon system which can carry out perfect combustion without taking out poisonous gas by combustion when incineration processing is required after use.

[0040]Although a ratio with the area B of the holdown-member end face in which the area A and a hollow fiber of a holdown-member side of a side which a hollow fiber exposes from a holdown member are carrying out the opening, i.e.,  $A/B$ , can choose any value, When an inside diameter and an outer diameter of a size of treatment capacity, a membrane area, a can, or a processing tub, handling nature, number of sheets of a hollow fiber that makes a sheet shaped, and a catchment pipe are taken into consideration, it is preferred to carry out a value of said  $A/B$  within the limits of 1.2-100.

[0041]A hollow fiber module of this invention has the feature which is described below. That is, since a hollow fiber is uniformly arranged to the whole holdown-member side expressed with the area A, the area B is the same, rather than a hollow fiber module of one, it becomes difficult to produce deposition of a suspended matter of a between [ hollow fibers ], and adhesion of hollow fibers, and  $A/B$  can perform efficiently effective use and scrubbing washing of a film surface.

[0042]Even if a hollow fiber number is the same hollow fiber module, resin which a direction of a hollow fiber module of  $A/B > 1$  uses as a holdown member can produce in a small quantity rather than  $A/B = 1$ . Therefore, in the case of resin which generates heat at the time of hardening, there is also little generation of heat, cure shrinkage also becomes small and with as much as possible little quantity of resin tends to fabricate it.

[0043]A hollow fiber module using a sheet shaped hollow fiber which consists of a hollow fiber knit fabric as shown in drawing 1 or drawing 2. That is, even if it is the hollow fiber module which has moreover carried out a value of  $A/B$  within the limits of 1.2-100 using a sheet shaped hollow fiber, Since an interval can be kept and a sheet shaped hollow fiber which deals with it rather than a hollow fiber module which has the same membrane area, and is excellent in a sex, and consists of a hollow fiber knit fabric can be arranged uniformly in and abroad, it becomes very easy to wash the hollow fiber surface uniformly in the case of film surface washing.

[0044]By using an interval of the hollow fibers which make a sheet shaped which consists of each hollow fiber knit fabric as a hollow fiber module carried out at equal intervals, the effect can be raised further.

[0045]Parallel arrangement is used so that a sheet shaped hollow fiber which especially consists of a hollow fiber knit fabric may pile up and be put together, when arranging two or more hollow fiber modules to a processing tub etc. and making it a hollow fiber module unit. And if all the sheet shaped hollow fibers in all the hollow fiber modules are fixed at equal intervals, it will become a hollow fiber module unit which can perform equivalent scrubbing washing to the whole hollow fiber, and decline in a partial filtration efficiency will not be caused.

[0046]When a margin is in the depth of a processing tub to height of a hollow fiber module, it is also possible to make it a hollow fiber module unit which laminates two or more hollow fiber modules, and it makes it come to arrange to a depth direction of a processing tub.

[0047]It is also possible to use them for it, making a depth direction of a processing tub laminate two or more hollow fiber module units which made a transverse direction arrange in parallel the two or more hollow fiber modules.

[0048]If a hollow fiber module unit is laminated and used for a depth direction when a processing tub can be made deep, It can be made to be able to concentrate on area to which air which can be made to reduce an installation area of a processing tub, and is used for scrubbing was restricted as compared with a time of using a shallow processing tub, and can be made a hollow fiber module unit which has higher washing efficiency.

[0049]An interval of modules is governed by size of a terminal area of an outer diameter of a catchment pipe, or a filtrate exit of a catchment pipe in the conventional hollow fiber module unit. On the other hand, by making it a hollow fiber module unit which was made to arrange two or more modules in parallel as the width of a holdown member is made larger than an outer diameter and a terminal area of a catchment pipe and the sides of a holdown member touched, and has been arranged, It becomes possible to fix a sheet shaped hollow fiber which consists of all the hollow fiber knit fabrics in all the hollow fiber modules at equal intervals, This can perform equivalent scrubbing washing to the whole hollow fiber, and it can make to a hollow fiber module unit which does not cause decline in a partial filtration efficiency.

[0050]An interval of the sheet shaped hollow fibers which consist of a hollow fiber knit fabric in a hollow fiber module, If it takes into consideration applying uniformly air bubbling at the time of scrubbing washing to the whole film surface, Although carrying out at equal intervals is desirable and the interval can be set up arbitrarily, efficiency of scrubbing washing in air bubbling etc., prevention from adhesion of an adjoining hollow fiber knit fabric, a membrane area per module, etc. are taken into consideration, It is preferred that an interval (distance) of sheet shaped hollow fibers shall be 5-100 mm.

[0051]That is, if hollow fibers will crowd too much and detergency will get worse, if an interval of the sheet shaped hollow fibers which consist of a hollow fiber knit fabric becomes narrower than 5 mm, and it exceeds 100 mm, a fall of a membrane area per volume which a filtration apparatus occupies will become remarkable.

[0052]It may be much more hard to produce fixing integration of hollow fibers by maintaining a predetermined interval and fixing a sheet shaped hollow fiber which consists of a hollow fiber knit fabric for every sheet.

[0053]If a hollow fiber module of a flat tip using a sheet shaped hollow fiber which consists of a hollow fiber

knit fabric is used, can perform what is called pressure filtration that allocates this hollow fiber module in a well-closed container, pressurizes treated water, and makes a hollow fiber penetrate, but. It is more desirable to allocate a hollow fiber module in an activated sludge tank, a settling tank, etc., and to perform suction filtration which attracts a side which collects treated water which penetrated a hollow fiber.

[0054]By adopting a filtration process what is called by the intermittent suction operating method which stops suction periodically especially temporarily, a film surface sediment can be efficiently prevented from entering inside a film surface, and processing frequency for functional recovery of a hollow fiber module can be reduced.

[0055]Although a range in which an interval of an intermission in the case of intermittent suction is clear since the optimal range changes with dirtiness of treated water cannot be specified, when aimed at about [ MLSS5000 mg/L ] activated sludge, a range for stop time 2 seconds – 15 minutes is preferred for suction time 1 to 30 minutes.

[0056]It becomes easy to perform circulating treated water within a tub at the time of filtration, or performing air bubbling and washing a film surface by performing a suction filtration method. As a cleaning method especially by air bubbling was described above, much more cleaning effect is acquired by combining with an intermittent suction operating method which can prevent a film surface sediment from entering inside a film surface efficiently. It is preferred that it makes a cleaning effect of a film surface of a hollow fiber raise as a flow of treated water in a suction filtration method becomes almost parallel to the length direction of a hollow fiber.

[0057]Many ss(es) and organic matters accumulate on a film surface in filtration of high polluted water. Therefore, a sediment is made to exfoliate using a stream, air, vibration, an ultrasonic wave, etc., and it is necessary to wash a film surface. In not washing, an organic matter deposited on a film surface causes a membranous blockade, and causes a fall of a filtering life. What is called cross flow filtration that passes a stream in parallel with a film surface as a concrete cleaning method, A method of causing a stream by pump or a motor, the bubbling method using a upflow of air, a method of vibrating the module itself, a method of vibrating a processed liquid with an ultrasonic wave, etc. are mentioned to a membrane module immersion tub. These washing may be continuously performed according to advance condition of a film surface blockade, and it may carry out intermittently.

[0058]In operating using together scrubbing washing by air bubbling, an aeration pipe for performing bubbling is needed. In order to perform suitable air bubbling, physical relationship of an aeration pipe and a module unit is important, but. Complicated work fixes a module unit and an aeration pipe independently, and when a module unit has moved during operation, there is a problem it becomes impossible for suitable scrubbing washing to perform in the middle of operation. By using an aeration pipe as this measure at a hollow fiber module unit which has carried out fixed unification, wearing to a can or a treating layer becomes easy, and scrubbing washing suitable during operation can be continued now.

[0059]Filtration treatment which uses a hollow fiber module of this invention is suitable when performing filtration of high polluted water especially, and as concrete field of application, solid liquid separation of filtration of river water, waterworks—for—industrial—use water filtration, and lower wastewater, waste water treatment (for example, processing with a combined septic tank), etc. are mentioned.

[0060]

[Effect of the Invention] The hollow fiber module of this invention becomes a compact structure though it is a large membrane area, and it becomes the structure where more hollow fibers contact treated water directly. For this reason, in the case of the filtration treatment using the hollow fiber module of this invention, the fixing integration between hollow fibers can be prevented effectively, and even if it is a time of filtering especially high polluted water, it becomes possible to maintain a high filtration efficiency over a long period of time.

[0061] In filtering by immersing the hollow fiber module of this invention which has used the sheet shaped hollow fiber which consists of a hollow fiber knit fabric especially in a processing tub, Since all the hollow fiber knit fabrics can be allocated at equal intervals so that the length direction of a hollow fiber may turn into the perpendicular direction, Even if it uses the hollow fiber module unit by two or more hollow fiber modules, this whole hollow fiber module unit can be covered, and scrubbing washing with equivalent sufficient efficiency can be carried out.

[0062] Wearing to a can or a processing tub and desorption are easy for the hollow fiber module of this invention, and it is excellent in handling nature.

[Brief Description of the Drawings]

[Drawing 1] It is a perspective view showing an example of a hollow fiber module.

[Drawing 2] It is a perspective view showing another example of a hollow fiber module.

[Drawing 3] It is a sectional view of the hollow fiber holding part in drawing 1 and the hollow fiber module of drawing 2.

[Description of Notations]

3 Hollow fiber open end side

5 Hollow fiber knit fabric

6 Housing and a catchment pipe

7 Holdown member

8 Conduit tube

9 Filtrate output port

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[Translation done.]